

APPENDIX B

DEVICE FOR CONTROLLING A SETUP/HOLD TIME CONTROL DEVICE OF AN INPUT SIGNAL

5 BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention generally relates to a device for controlling a setup/hold time control device of an input signal, and more specifically, to a technique to control the setup/hold time of various control signals applied from an input buffer by a software operation command without physically changing the control device.

2. Description of the Prior Art

15 [0002] Fig. 1 is a circuit diagram illustrating a conventional device for controlling setup/hold time control device of input signal.

[0003] The conventional device for controlling a setup/hold time control device of an input signal comprises inverters 20 IV1-IV4 for performing a driver function, MOS capacitors C1-C4 for performing a signal delay function, metal option unit 2 and 3, and a latch 4.

[0004] Here, the inverters IV1 and IV2 output output signals by driving an address, a command signal or input data 25 applied from an input buffer 1. The inverter IV3 outputs a signal by driving an output signal of the metal option unit 2. The inverter IV4 drives an output signal of the metal option unit 3 to provide a global bus line control signal GB_BL to the latch 4.

30 [0005] The metal option units 2 and 3 comprising metal option

switches M01-M04 selectively control the MOS capacitors C1-C4 to control ~~setup/hold~~setup/hold time of the global bus line control signal GB_BL.

[0006] The MOS capacitors C1 and C2 are ~~selectively~~selectively connected to an output terminal of the inverter IV2 by the metal option switches M01 and M02. The MOS capacitors C3 and C4 are selectively connected to an output terminal of the inverter IV3 by the metal option switches M03 and M04.

[0007] The latch 4 latches the global bus line control signal GB_BL in ~~synchronization with~~synchronous to a clock signal CLK to output the latched signal into a global bus line (not shown). Here, in order that the global bus line control signal GB_BL inputted into the latch 4 may be valid, the global bus line control signal GB_BL should be transmitted into the latch earlier than the clock signal CLK by a predetermined time (setup time). When the latch 4 performs a latch operation in ~~synchronization with~~synchronous to the clock signal, a state of the global bus line control signal GB_BL should be maintained for a predetermined time (hold time).

[0008] Here, ~~it is most~~the ideal condition is that the clock signal CLK is enabled after the setup time of the global bus line control signal GB_BL has passed, and the state of the global bus line control signal GB_BL for the hold time has been maintained.

[0009] However, it is difficult to satisfy the above ideal condition because signals inputted ~~externally from~~outside of an actual chip through the input buffer 1 are influenced by length of an internal transmission line, various noises, capacitance or resistance, and so forth.

[0010] Accordingly, the ~~conventional device for controlling a setup/hold~~time control device of an input signal is

designed to control the setup/hold time of the global bus line control signal GB_BL by selectively connecting signal delay devices such as the MOS capacitors C1~C4 ~~for delaying signals to the drivers IV1~IV4.~~

5 ~~[0011]~~ In other words, the metal option switches MO1~MO4 ~~needing~~requiring physical apparatus are used to regulate the setup/hold time of the global bus line control signal GB_BL. As a result, since ~~variations in circuits of metal layers are required~~need to be physically changed to
10 regulate the setup/hold time, the conventional device has a problem of ~~physically consuming~~a long time and a high cost consumption.

SUMMARY OF THE INVENTION

15 ~~In order to overcome the above-described problem, the~~[0012]
The present invention has an object is directed to provide a setup/hold time control device to appropriately control a device for controlling a setup/hold time of an input signal that controls a setup/hold time of various
20 control signals applied to a global bus line by controlling setup/hold time of various signals applied from an input buffer according to a decoded test mode control signal.

[0013] There is provided a device for controlling a setup/hold time control apparatus of an input signal,
25 comprising: a driver for outputting a global bus line control signal by drivingamplifying an output signal from
an input buffer, a signal delay unit for delaying the global bus line control signal selectivelysignal selectively
connected to the driver, a decoding unit for outputting a
30 test mode delay signal by decoding a test control signal for determining to control setup/hold time corresponding to the global bus line control signal, a test mode entry

signal, and a test mode ~~endexit~~ signal~~7~~, and a delay control unit for controlling the setup/~~hold~~hold time of the global bus line control signal by selectively connecting the signal delay unit to the driver according to a state of the test mode delay signal.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Fig. 1 is a circuit diagram illustrating a conventional device for controlling a setup/hold time ~~control device~~of an input signal .

[0015] Fig. 2 is a circuit diagram illustrating a device for controlling a setup/hold time ~~control device~~of an input signal according to an embodiment of the present invention.

[0016] Fig. 3 is a circuit diagram illustrating a decoding unit according to an embodiment of the present invention.

[0017] Fig. 4 is ~~an operating~~a timing diagram illustrating operation of a device for controlling a setup/hold time ~~control device~~of an input signal according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] The present invention will be described in detail referring to the accompanying drawings.

[0019] Fig. 2 is a circuit diagram illustrating a device for controlling a setup/hold time ~~control device~~of an input signal according to an embodiment of the present invention.

[0020] Referring to Fig. 2, the device for controlling a setup/hold time ~~control device~~of an input signal of the present invention comprises a driver 20, signal delay units 30 and 40, delay control units 50 and 60, and a latch 70.

[0021] The driver 20 comprises inverters IV5-IV8 for outputting a global bus line control signal GB_BL into a

latch 70 by driving an address ~~applied from an input buffer~~
10, a command signal or input data ~~applied from an input~~
buffer 10. Here, the inverters IV5 and IV6 output signals
by driving an output signal of the input buffer 10. The
5 inverter IV7 outputs a signal by driving an output signal
of the delay control unit 50. The inverter IV8 drives an
output signal of the delay control unit 60 to provide the
global bus line control signal GB_BL to the latch 70.

[0022] The signal delay unit 30 comprises MOS capacitors C5
10 and C6 selectively connected to an output terminal of the
inverter IV6 controlled by the delay control unit 50. The
signal delay unit 40 comprises MOS capacitors C7 and C8
selectively connected to an output terminal of the inverter
IV7 controlled by the delay control unit 60.

15 [0023] The delay control unit 50 comprising an inverter IV9
and transmission gates T1 and T2 selectively
~~controls~~ connects MOS capacitors C5 and C6 to control the
setup/hold time of the global bus line control signal GB_BL
provided to the latch 70. The inverter IV9 inverts a test
20 mode delay signal TM_DLY<0>. The transmission gates T1 and
T2 selectively connects the MOS capacitors C5 and C6 to the
output terminal of the inverter IV6 according to a state of
the test mode delay signal TM_DLY<0>.

[0024] Here, the transmission gates T1 and T2 receive the test
25 mode delay signal TM_DLY<0> through a NMOS gate, and the
~~inverted~~ inversion of the test mode delay signal TM_DLY<0>
by the inverter IV9 through a PMOS gate.

[0025] The delay control unit 60 comprising an inverter IV10
and transmission gates T3 and T4 selectively
30 ~~controls~~ connects MOS capacitors C7 and C8 to control the
setup/hold time of the global bus line control signal GB_BL
provided to the latch 70. The inverter IV10 inverts a test

mode delay signal TM_DLY<1>. The transmission gates T3 and T4 selectively connects the MOS capacitors C7 and C8 to the output terminal of the inverter IV7 according to a state of the test mode delay signal TM_DLY<1>.

5 [0026] Here, the transmission gates T3 and T4 receive the test mode delay signal TM_DLY<0> through a NMOS gate, the test mode delay signal TM_DLY<1> through a PMOS gate, and the inverted inversion of the test mode delay signal TM_DLY<1> by the inverter IV10 through a NMOS gate.

10 [0027] The latch 70 latches the global bus line control signal GB_BL in synchronization with synchronous to a clock signal CLK to output the latched signal into a global bus line (not shown).

[0028] Fig. 3 is a circuit diagram illustrating a decoding unit for controlling generating the test mode delay signal TM_DLY<0> of Fig. 2.

[0029] The decoding unit comprises a logic unit 80 and latches 90 and 100. The logic unit 80 logically operates a test control signal TCS and a test mode entry signal TM_EP. The latches 90 and 100 latches an output signals signals of the logic unit 80 and an test mode endexit signal TM_EXP to output a test mode delay signals signals TM_DLY<1:0>.

[0030] Here, the logic unit 80 comprises an inverter IV11 and NAND gates ND1 and ND2. The inverter IV11 inverts a test control signal TCS. The NAND gate ND1 NANDs a the test control signal TCS and the test mode entry signal TM_EP. The NAND gate ND2 NANDs the test mode entry signal TM_EP and an output signal of the inverter IV11.

[0031] The latch 90 comprises two cross-coupled NAND gates ND3 and ND4 for feeding back each with an output signal as of a NAND gate fed back to an input signal each of the other NAND gate. A NAND gate ND3 NANDs an output signal of the NAND

gate ND1 and an output signal of the NAND gate ND4 to output the test mode delay signal TM_DLY<0>. The NAND gate ND4 NANDs the test mode ~~endexit~~ signal TM_EXP and an output signal of the NAND gate ND3.

5 [0032] The latch 100 comprises two cross-coupled NAND gates ND5 and ND6 ~~for feeding back each with an output signal as of~~ a NAND gate fed back to an input signal ~~each of the other~~ NAND gate. The NAND gate ND5 NANDs an output signal of the NAND gate ND2 and an output signal of the NAND gate ND6 to
10 output the test mode delay signal TM_DLY<1>. The NAND gate ND6 NANDs the test mode ~~endexit~~ signal TM_EXP and an output signal of the NAND gate ND5.

[0033] The operation process ~~eof~~ the device for controlling setup/hold time ~~control device of input signal~~ is described
15 referring to Fig. 4.

[0034] In a case of a normal operation mode, the test mode delay signal ~~signals~~ TM_DLY<1:0> ~~becomes~~ are maintained at a low state. When the test mode delay signal TM_DLY<0> is at a low state, the transmission gates T1 and T2 are all
20 turned off, and outputs of the MOS capacitors C5 and C6 do not affect an output terminal of the inverter IV6. When the test mode delay signal TM_DLY<1> is at a low state, the transmission gates T3 and T4 are turned on, and an output terminal of the inverter IV7 is connected to the MOS
25 capacitors C7 and C8. As a result, an output signal of the inverter IV7 is delayed by the MOS capacitors C7 and C8, and the global bus line control signal GB_BL is delayed.

[0035] In order to delay the setup/hold time of the global mode delay signal GB_BL in a test mode state, the decoding
30 unit is controlled ~~to have for~~ the test mode delay signal TM_DLY<0> to be at a high level. On the other hand, in order to advance the setup/hold time of the global bus line

control signal GB_BL, the delay unit is controlled to have for the test mode delay signal TM_DLY<1> to be at a high level.

5 [0036] When the test control signal TCS is at a high level, in order to delay the setup/hold time of the global bus line control signal GB_BL, the test mode entry signal TM_EP is enabled to a high level.

10 [0037] When the test mode entry signal TM_EP is enabled to the high level, the NAND gate ND1 of the logic unit 80 outputs a low signal, and the NAND gate ND2 outputs a high signal. Then, the latch 90 outputs the test mode delay signal TM_DLY<0> at the high level, and the latch 100 outputs the test mode delay signal TM_DLY<1> at the low level.

15 [0038] Thereafter, when the test mode delay signal TM_DLY<0> becomes ~~at the high level~~, the transmission gates T1 and T2 of the delay control unit 50 are all turned on, and an output signal of the inverter IV6 is delayed by the MOS capacitors C5 and C6. When the test mode delay signal TM_DLY<1> becomes ~~at the low level~~, the transmission gates
20 T3 and T4 of the delay control unit 60 are all turned on, and an output signal of the inverter IV10 is delayed by the MOS capacitors C7 and C8.

25 [0039] Next, when a test mode ~~endexit~~ signal /TM_EXP~~b~~EXP is generated, the test mode delay signal TM_DLY<0> is disabled to the low level, and maintained at a normal state.

[0040] As a result, when the test control signal TCS is at the high level, the test mode delay signal TM_DLY<0> becomes ~~at the high level~~ to delay the setup/hold time of the global bus line control signal GB_BL.

30 [0041] On the other hand, when the test control signal TCS ~~is~~ at the becomes low level, the test mode entry signal TM_EP is enabled to the high level to advance the setup/hold time

of the global bus line control signal GB_BL.

[0042] When the test mode entry signal TM_EP is enabled to the high level, the NAND gate ND1 of the logic unit 80 outputs a high signal, and the NAND gate ND2 outputs a low signal.

5 Then, the latch 90 outputs the test mode delay signal TM_DLY<0> at the low level, and the latch 100 outputs the test mode delay signal TM_DLY<1> at the high level.

[0043] Next, when the test mode delay signal TM_DLY<0> becomes at the low level, the transmission gates T1 and T2 of the delay control unit 50 are all turned off, and output signal of the inverter IV6 is not delayed. When the test mode delay signal TM_DLY<1> becomes at the high level, the transmission gates T3 and T4 of the delay control unit 60 are all turned off, and an output signal of the inverter
15 IV7 is not delayed.

[0044] Thereafter, when the test mode endexit signal /TM_EXPbEXP is generated, the test mode delay signal TM_DLY<1> is disabled to the low level, and maintained at a normal state.

20 [0045] Accordingly, when the test control signal TCS is at the low level, the test mode delay signal TM_DLY<1> becomes at the high level to advance the setup/hold time of the global bus line control signal GB_BL.

[0046] As discussed earlier, a setup/hold time control signal of the present invention can optimize the setup/hold time
25 with a small cost by changing the setup/hold time of control signals outputted from an input buffer by software operation commands without any physical variation in metal layers without physically changing the control device.